

Annex 6: WGITMO Input to REGNS

WGITMO input to REGNS - Introduced aquatic species of the North Sea coasts and adjacent brackish waters

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Considerable new literature is available on introduced (aquatic) species in north-western Europe because such species are of increasing concern in the regulatory and scientific community. One of the first summaries of aquatic invaders in the region was made by Gollasch (1996), with a focus on the German North- and Baltic Sea coasts. In 1997 Eno *et al.* published a summary of aquatic alien species in the United Kingdom. In 1999 Nehring and Leuchs published an overview of “neobiota” of the German coast. In the same year Reise *et al.* published an overall summary of invaders in the North Sea region. Nehring (2005) updated the inventory of introduced aquatic species in Germany, Jensen and Knudsen (2005) published an inventory of introduced species in Denmark. A comprehensive inventory of alien species in Dutch coastal waters was also published in 2005 by Wolff. An update of the 1999 summary of introduced species in the North Sea is in press (Gollasch *et al.*, in press). It forms the basis of this overview.

In total 219 non-native taxa (including cryptogenic species) were reported in the North Sea. 95 % of these taxa are introduced by man, predominantly with shipping and intentional introductions for stocking or aquaculture purposes (Table 1), 16 % of these taxa are cryptogenic species and 6 % have most likely reached the North Sea by their own means: drifting with currents, swimming, or by other ways of natural range expansion. The most recently recorded species are *Rapana venosa* and *Neogobius melanostomus*, which were both recorded for the first time in the North Sea in 2005 (Kerckhof *et al.*, 2006, van Beek, 2006).

More than half of the invaders known have established self-sustaining populations. For the rest of the recorded introduced species the population status is unknown. Some species were only recorded for a certain time period and became locally extinct thereafter. With 193 species (88%) marine taxa are dominating. However, the share of marine vs. brackish water invaders varies by country - but marine species are dominating in each country. The dominating vectors of introduction are the shipping-associated vectors hull fouling and ballast water release, and species introductions for aquaculture purposes and their associated biota (thus target and non-target species) (Figure 1).

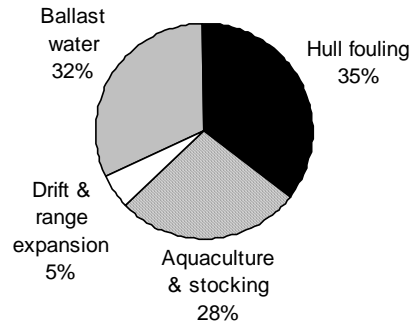


Figure 1. Key vectors of introduction for nonindigenous species found in the North Sea.

Resume

It is interesting to note that 13 species have reached the North Sea by drift or range expansion – a possible indication of a changing climate regime as several of these species are known from warmer climate regions and have now been found in colder waters. Wiltshire (pers. comm.) and Franke and Gutow (2004) stated that several nonindigenous species were newly recorded in the North Sea near Helgoland which were previously known to have an eastwards distribution limit in the English Channel or were known only from the Mediterranean Sea. It is assumed that the increasing number of records of species from warmer waters might be a consequence of increasing water temperatures.

Reise *et al.* (1999) concluded that in the North Sea introduced species in most cases are more "additive" without causing major unwanted impacts. However, the introduced Pacific oyster *Crassostrea gigas* has recently spread in the coastal waters of the North Sea (Reise *et al.*, 2005) with competitive impact on mussel beds of the native blue mussel *Mytilus edulis*. The spread is likely promoted due to (a) the recent warm summers which support the recruitment of the Pacific oyster (Diederich *et al.*, 2005) and also (b) due to the lack of cold winters which are required for good recruitment of *M. edulis*. It is assumed that the current success of *C. gigas* may reverse in case water temperatures change (Diederich, 2005). In other European regions devastating effects of introduced species are known [e.g. the comb jelly *Mnemiopsis leidyi* in the Black Sea (GESAMP, 1997) or the green alga *Caulerpa taxifolia* in the Mediterranean Sea (Boudouresque *et al.*, 1992)]. However, negative impacts of the above mentioned species may be temporary only and are also subject of controversy. In general terms, biological and habitat impacts of introduced species are difficult to assess and monetary impact calculations are not available. It should also be noted that impacts of recently introduced species are often not immediately apparent

The rate of invasions has increased in the North Sea, as it has increased worldwide, and it will probably continue to increase due to the effects of climate change. There is a need for biological and monetary impact assessments and knowledge of the invasion process is essential in designing management plans to cope with the potential detrimental effects of invasive species, and to attempt to prevent their large-scale spread

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Table 1 Introduced marine and brackish species from the North Sea with an indication of records per country excluding cryptogenic species and species which arrived by drift or range expansion. BE = Belgium, DK = Denmark, GE = Germany, NL = The Netherlands, NO = Norway, SE = Sweden and UK = United Kingdom. A question mark indicates that the species most likely occurs in the country, but records are not yet confirmed. Species without vector indication means the introduction vector is unknown. Key references: Gollasch, 1996; Eno *et al.*, 1997; Reise *et al.*, 1999; Weidema, 2000; Jensen and Knudsen, 2005; Nehring, 2005; Wolff, 2005.

Species	Group	Country								Status	Habitat	Ballast	Fouling	Aquacult or stock.
<i>Acartia tonsa</i>	Copepod	GE	DK			BE	NL	UK	SE	establ.	marine	x		
<i>Agardhiella subulata</i>	Macroalga						NL	UK		establ.	marine		x	
<i>Aglaothamnion halliae</i>	Macroalga	GE		NO					SE	establ.	marine		x	
<i>Alexandrium angustitubulatum</i>	Dinoflagellate								SE	uncertain	marine	x		
<i>Alexandrium leei</i>	Dinoflagellate					NL				establ.	marine	x		x
<i>Alkmaria romijni</i>	Annelida		DK	NO		NL				establ.	marine	x	x	
<i>Ammonothea hilgendorfi</i>	Pycnogonida							UK		establ.	marine		x	
<i>Anguillicola crassus</i>	Nematod	GE	DK	NO	?	NL	UK	SE		establ.	marine			x
<i>Anotrichium furcellatum</i>	Macroalga					NL	UK			establ.	marine		x	
<i>Antithamnionella spirographidis</i>	Macroalga					BE	NL	UK		establ.	marine		x	
<i>Antithamnionella ternifolia</i>	Macroalga	GE				BE	NL	UK		establ.	marine		x	
<i>Aphelocheata marioni</i>	Polychaete	GE				NL	UK			establ.	marine	x	x	
<i>Asparagopsis armata</i>	Macroalga					NL	UK			establ.	marine		x	
<i>Asperococcus scaber</i>	Macroalga					NL	UK			establ.	marine		x	x
<i>Atherina boyeri</i>	Pisces					NL				establ.	marine		x	
<i>Aulacomya ater</i>	Bivalve							UK		unestabl.	marine		x	
<i>Balanus amphitrite amphitrite</i>	Cirriped					BE	NL	UK		establ.	marine		x	
<i>Balanus eburneus</i>	Cirriped					NL				extinct	marine		x	
<i>Bonamia ostreae</i>	Protozoa					NL				establ.	marine			x
<i>Bonnemaisonia hamifera</i>	Macroalga	GE	DK	NO	?	NL	UK	SE		establ.	marine		x	
<i>Botrylloides violaceus</i>	Tunicata					NL				establ.	marine		x	
<i>Bougainvillia macloviana</i>	Cnidaria	GE								extinct	marine		x	
<i>Brachynotus sexdentatus</i>	Crustacean							UK		uncertain	marine	x	x	
<i>Branchiommia bombyx</i>	Annelida					NL				extinct	marine	x	x	
<i>Callinectes sapidus</i>	Decapod	GE				BE	NL			establ.	marine	x		
<i>Calyptraea chinensis</i>	Gastropod					NL				extinct	marine			x

Species	Group	Country							Status	Habitat	Ballast	Fouling	Aquacult or stock.
Caprella mutica	Amphipod	GE		NO	BE	NL	UK		establ.	marine	x	x	
Cereus pedunculatus	Cnidaria	GE					UK		uncertain	marine	x	x	
Chattonella antiqua	Rhaphidophyceae	GE				NL			establ.	marine	x		
Chattonella marina	Rhaphidophyceae	GE				NL			establ.	marine	x		
Chelicorophium curvispinum	Amphipod	GE				NL			establ.	brackish	x		
Chionoecetes opilio	Decapod			NO					uncertain	marine	x	x	
Clavopsella navis	Cnidaria	?					UK		uncertain	brackish		x	
Clymenella torquata	Polychaete						UK		uncertain	marine	x	x	
Codium fragile ssp. atlanticum	Macroalga			NO		NL	UK		establ.	marine		x	
Codium fragile ssp. scandinavicum	Macroalga		DK	NO				SE	establ.	marine		x	
Codium fragile ssp. tomentosoides	Macroalga	GE	DK	NO	BE	NL	UK	SE	establ.	marine		x	
Colaconema dasyae	Macroalga					NL			establ.	marine		x	
Colpomenia peregrina	Macroalga	GE	DK	NO		NL	UK	SE	establ.	marine			x
Conchoderma auritum	Cirriped					NL			extinct	marine		x	
Corambe obscura (=batava)	Gastropod					NL			extinct	marine			
Cordylophora caspia	Cnidaria	GE	DK	NO	?	NL		SE	establ.	marine		x	
Corethron criophilum	Diatom	GE							establ.	marine	x		
Corophium (= Monocorophium) sextonae	Amphipod	GE		NO		NL	UK		establ.	marine	x	x	
Corynophlaea umbellata	Macroalga						UK		establ.	marine		x	
Coscinodiscus wailesii	Diatom	GE		NO	BE	NL	UK	SE	establ.	marine	x		x
Cotula coronopifolia	Tracheophyta	GE				NL			establ.	brackish			
Crassostrea gigas	Bivalve	GE	DK	NO	BE	NL	UK		establ.	marine			x
Crassostrea virginica	Bivalve	GE				NL	UK		unestabl.	marine			x
Crepidula fornicata	Gastropod	GE	DK	NO	BE	NL	UK	SE	establ.	marine			x
Dasya baillouviana	Macroalga	GE	DK	NO		NL		SE	establ.	marine		x	
Desdemona ornata	Polychaete						UK		uncertain	marine	x	x	
Diadumene lineata	Cnidaria	GE				NL	UK		establ.	marine		x	x
Dicroerisma psilonereia	Dinoflagellate							SE	establ.	marine	x		
Didemnum sp.	Tunicata					NL			establ.	marine			
Diplosoma listerianum	Tunicata					NL			establ.	marine		x	x

Species	Group	Country						Status	Habitat	Ballast	Fouling	Aquacult or stock.
Elachista sp.	Macroalga					NL		establ.	marine			
Elminius modestus	Cirriped	GE	DK		BE	NL	UK	establ.	marine		x	
Ensis directus	Bivalve	GE	DK	NO	BE	NL	UK	SE	establ.	marine	x	
Eriocheir sinensis	Decapod	GE	DK	NO	BE	NL	UK	SE	establ.	marine	x	
Euplana gracilis	Turbellaria					NL		uncertain	marine		x	
Eurytemora americana	Copepod					NL	UK	establ.	brackish	x		
Eusarsiella zostericola	Ostracod						UK	establ.	brackish			x
Fibrocapsa japonica	Rhaphidophyceae	GE				NL		establ.	marine	x		
Ficopomatus enigmaticus	Polychaete	GE			BE	NL	UK	establ.	marine		x	
Fucus evanescens	Macroalga		DK	NO			UK	SE	establ.	marine	x	
Gammarus tigrinus	Amphipod	GE				NL		SE	establ.	brackish		x
Garveia (=Bimeria) franciscana	Cnidaria	GE			BE	NL		establ.	brackish		x	
Gonionemus vertens	Cnidaria	GE		NO	BE	NL	UK	SE	establ.	marine	x	x
Gracilaria vermiculophylla	Macroalga	GE	DK			NL		SE	establ.	marine	x	
Grandidierella japonica	Amphipod						UK	uncertain	marine	x		
Grateloupia filicina var. luxurians	Macroalga						UK	establ.	marine			x
Grateloupia turuturu (= doryphora)	Macroalga					NL	UK	establ.	marine		x	x
Gymnodinium catenatum	Dinoflagellate					NL		establ.	marine	x		
Gymnodinium cf. nagasakiense	Dinoflagellate			NO		NL		establ.	marine	x		
Gyrodinium corallinum	Dinoflagellate							SE	establ.	marine	x	
Haliclona (= Porifera Acervochalina) loosanoffi		GE				NL		uncertain	marine		x	
Haplosporidium armoricanum	Protozoa					NL		extinct	marine			x
Hemigrapsus penicillatus	Decapod				BE	NL		establ.	marine	x	x	
Hemigrapsus sanguineus	Decapod					NL		uncertain	marine	x		
Heterosiphonia japonica	Macroalga			NO		NL	UK	SE	establ.	marine	x	x
Homarus americanus	Decapod			NO				unestabl.	marine			x
Hydroides dianthus	Polychaete						UK	establ.	marine	x	x	
Hydroides elegans	Polychaete	GE				NL	UK	establ.	brackish	x	x	
Hydroides ezoensis	Polychaete						UK	unestabl.	marine	x	x	x

Species	Group	Country							Status	Habitat	Ballast	Fouling	Aquacult or stock.
Imogine necopinata	Turbellaria					NL			uncertain	brackish			x
Incisocalloipe aestuarius	Amphipod				BE	NL			establ.	brackish	x		
Janua brasiliensis	Polychaete					NL	UK		uncertain	marine		x	x
Karenia (=Gymnodinium) aureolum	Dinoflagellate	GE		NO			UK		establ.	marine	x		
Karenia (=Gymnodinium) mikimotoi	Dinoflagellate	GE	DK	NO	BE	NL	UK	SE	establ.	marine	x		
Laminaria ochotensis	Macroalga	GE							uncertain	marine		x	
Leathesia verruculiformis	Macroalga					NL			establ.	marine		x	
Lebistes reticulatus	Pisces	GE				NL			establ.	brackish			x
Lepidopleurus cancellatus	Polyplacophora					NL			extinct	marine			x
Limulus polyphemus	Xiphosura	GE	DK			NL			unestabl.	marine			x
Marenzelleria viridis	cf. Annelida	GE	DK			NL	UK	SE	establ.	brackish	x		
Marenzelleria wireni	cf. Annelida	GE	DK	NO	BE	NL			establ.	marine	x		
Marsupenaeus (=Penaeus) japonicus	Prawn			NO					unestabl.	marine			x
Marteilia refringens	Protozoa					NL			extinct	marine			x
Megabalanus coccopoma	Cirriped				BE	NL			establ.	marine		x	
Megabalanus tintinnabulum	Cirriped				BE				establ.	marine		x	
Melita nitida	Amphipod					NL			establ.	marine	x	x	
Mercenaria mercenaria	Bivalve					NL	UK		establ.	marine			x
Micropogonias undulatus	Pisces					NL			uncertain	marine	x		
Muggiaea atlantica	Cnidaria	GE							uncertain	marine	x		
Mya arenaria	Bivalve	GE	DK	NO	BE	NL	UK	SE	establ.	marine	x	x	
Myicola ostreae	Copepod					NL			uncertain	marine			x
Mytilicola intestinalis	Copepod	GE	DK			NL			establ.	marine			x
Mytilicola orientalis	Copepod					NL			establ.	marine			x
Mytilopsis (=Congeria) leucophaeta	Bivalve	GE			BE	NL	UK		establ.	brackish	x		
Nematostella vectensis	Cnidaria						UK		establ.	brackish		x	
Nemopsis bachei	Cnidaria	GE		NO		NL			establ.	brackish	x	x	
Neogobius melanostomus	Pisces					NL			establ.	brackish	x		

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Neosiphonia (= Polysiphonia) harveyi	Macroalga	GE	DK	NO	BE	NL	UK	SE	establ.	marine		x	
Ocenebra erinacea	Gastropod		DK		BE		UK		uncertain	marine			x
Odontella sinensis	Diatom	GE	DK	NO	BE	NL	UK	SE	establ.	marine	x		
Oncorhynchus gorboscha	Pisces			NO					uncertain	marine			x
Oncorhynchus keta	Pisces			NO					extinct	marine			x
Oncorhynchus kisutch	Pisces					NL			extinct	marine			x
Oncorhynchus mykiss (=Salmo gairdneri)	Pisces	GE	DK	NO		NL			establ.	marine			x
Orchestia cavimana	Amphipod	GE			BE	NL			establ.	brackish	x		
Ostroumovia inkermanica	Cnidaria					NL			extinct	brackish	x	x	
Palaemon macrodactylus	Shrimp				BE	NL	UK		establ.	marine	x		
Palinurus elephas	Decapod					NL			extinct	marine		x	x
Paralithodes camtschatica	Decapod			NO					establ.	marine			x
Pecten maximus	Bivalve					NL			extinct	marine			x
Petricola pholadiformis	Bivalve	GE	DK	NO	BE	NL	UK	SE	establ.	marine			x
Pileolaria berkeleyana	Polychaete						UK		establ.	marine		x	
Pilumnus hirtellus	Crustacean							SE	unestabl.	marine	x	x	
Pleurosigma planctonicum	Phytoplankton					NL	UK		establ.	marine	x		
Polydora hoplura	Annelida					NL			uncertain	marine			x
Polysiphonia senticulosa	Macroalga				BE	NL			establ.	marine			x
Porphyra miniata	Macroalga		DK						establ.	marine		x	
Porphyra umbilicalis	Macroalga	GE							uncertain	marine		x	
Porphyrostromium sp.	Macroalga					NL			uncertain	marine			
Prorocentrum redfieldii	Dinoflagellate	GE				NL			establ.	marine	x		
Pseudobacciger harengulae	Trematoda							SE	establ.	marine			x
Pseudodactylogyrus anguillae	Plathelminthes		DK	NO					establ.	brackish			x
Pseudodactylogyrus bini	Plathelminthes			NO					establ.	brackish			x
Pseudorasbora parva	Pisces						UK		uncertain	marine			x
Pterosiphonia pinnulata	Macroalga						UK		establ.	marine		x	x
Rapana venosa	Gastropod					NL	UK		uncertain	marine	x		x

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Rhithropanopeus harrisii	Decapod	GE			BE	NL			establ.	brackish		x	
Ruditapes (=Tapes) philippinarum	Bivalve			NO					establ.	marine			x
Sabellaria spinulosa	Polychaete	GE							establ.	marine	x	x	
Salmo (=Onchorhynchus) clarki	Pisces		DK						establ.	marine			x
Sargassum muticum	Macroalga	GE	DK	NO	BE	NL		SE	establ.	marine		x	x
Scytosiphon dotyi	Macroalga						UK		establ.	marine			x
Smittoidea prolifica	Bryozoan					NL			establ.	marine			x
Solidobalanus fallax	Cirriped			NO	BE				uncertain	marine		x	
Spartina anglica	Anthophyta	GE			BE	NL	UK		establ.	marine			x
Spartina townsendii	x Anthophyta	GE	DK		BE	NL			establ.	marine			x
Spisula solidissima	Bivalve					NL			unestabl.	marine	x		
Stephanopyxis palmeriana	Diatom	GE			BE	NL	UK	SE	establ.	marine	x		
Styela clava	Tunicata	GE	DK		BE	NL	UK		establ.	marine		x	x
Syllidia armata	Polychaete					NL			extinct	marine			x
Syllis gracilis	Polychaete					NL			extinct	marine			x
Telmatogeton japonicus	Chironomid	GE	DK	NO	BE	NL	UK		establ.	marine	x	x	
Teredo navalis	Bivalve	GE	DK	NO	BE	NL	UK	SE	establ.	marine		x	
Thalassiosira hendeyi	Diatom	GE			BE	NL	UK		establ.	marine	x		x
Thalassiosira punctigera	Diatom	GE		NO	BE	NL	UK	SE	establ.	marine	x		x
Thalassiosira tealata	Diatom			NO	BE	NL	UK		establ.	marine	x		x
Tharyx killariensis	Polychaete	GE							establ.	marine	x	x	
Thecadinium yashimaense mucosum (=)	Dinoflagellate	GE							uncertain	marine	x		
Thieliana navis	Cnidaria					NL			establ.	brackish	x	x	
Tricellaria inopinata	Bryozoan				BE	NL	UK		establ.	marine		x	
Trinectes maculatus (=Achirus fasciatus)	Pisces					NL			unestabl.	marine	x		
Ulva pertusa	Macroalga					NL			establ.	marine			
Undaria pinnatifida	Macroalga				BE	NL	UK		establ.	marine			x
Urosalpinx cinerea	Gastropod						UK		uncertain	marine			x
Verrucophora fascima	cf. Dinoflagellate							SE	establ.	marine	x		